

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-347052

(43)Date of publication of application : 05.12.2003

(51)Int.Cl.

H05B 33/14

H05B 33/02

(21)Application number : 2002-147395

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(22)Date of filing : 22.05.2002

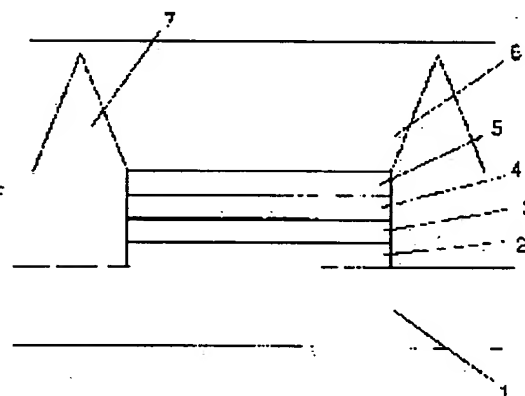
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(54) ORGANIC ELECTROLUMINESCENT ELEMENT, DISPLAY DEVICE AND MOBILE TERMINAL USING SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an organic electroluminescent element capable of maintaining high luminous efficiency, and a display device and a mobile terminal using the same.

SOLUTION: The organic electroluminescent element has a substrate 1 having thereon at least an anode 2 for injecting a hole, a luminescent layer 4 having a luminescent region, and a cathode 5 for injecting electrons, and is equipped with a light angle conversion panel 6 on the element forming surface side of the substrate 1.



LEGAL STATUS

[Date of request for examination]

28.04.2005

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

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CLAIMS

[Claim(s)]

[Claim 1] The organic electroluminescent element which is an organic electroluminescent element equipped with the anode plate which pours in an electron hole at least on a substrate, the luminous layer which has a luminescence field, and the cathode which pours in an electron, and is characterized by having the include-angle conversion panel of light at the component forming face side of said substrate.

[Claim 2] The include-angle conversion panel of said light is an organic electroluminescent element according to claim 1 characterized by being joined through the protective coat prepared in the component forming face of said substrate.

[Claim 3] The include-angle conversion panel of said light is claim 1 and the organic electroluminescent element given [any 1] in two which are characterized by the optical ejection side consisting of the diffusing surface.

[Claim 4] The include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by having two or more slots parallel to the one direction of field inboard - given [any 1] in three.

[Claim 5] The include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by having two or more slots parallel to the 2-way which intersects perpendicularly mutually [field inboard] - given [any 1] in four.

[Claim 6] The slot formed in the include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by being linear V typeface slot where the cross-section configuration consists of a straight line which is two of abbreviation V typefaces - given [any 1] in five.

[Claim 7] The slot formed in the include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by being rounded V typeface slot where the cross-section configuration consists of a curve **** to the inside of an abbreviation V typeface - given [any 1] in five.

[Claim 8] The slot formed in the include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by being a symmetrical configuration - given [any 1] in seven.

[Claim 9] The slot formed in the include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by being an unsymmetrical configuration - given [any 1] in seven.

[Claim 10] The slot formed in the include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by coming to form a light reflex side in the side face at least - given [any 1] in nine.

[Claim 11] The slot formed in the include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by coming at least to form in the side face the field which consists of a medium with a refractive index smaller than the include-angle conversion panel of said light - given [any 1] in nine.

[Claim 12] The coefficient of thermal expansion of the medium which forms the include-angle conversion panel of said light is an organic electroluminescent element claim 1 characterized by being 80% or more of the coefficient of thermal expansion of said substrate, and less than 120% - given [any 1] in 11.

[Claim 13] an organic electroluminescent element claim 1 - given [any 1] in 12 -- using -- said anode plate -- the shape of a stripe -- each -- it dissociates electrically -- having -- said cathode -- the shape of a stripe -- each -- the organic electroluminescence display characterize by for the direction of the slot which is separate electrically , is constitute , has an image display array , and is carve by the include angle conversion panel of said light and the direction of the pixel form with one of stripe electrodes to are the same .

[Claim 14] An organic electroluminescent element claim 1 - given [any 1] in 12 is used. Said anode plate, Either of said cathode is separated and constituted by the individual electrical-and-electric-equipment target for every pixel. Or said separated electrode The organic electroluminescence display characterized by being characterized by the direction of the slot which has an image display array with an image display array, and is carved by the include-angle conversion panel of said light by being scanned through at least one or more switching elements and the direction of a pixel being the same.

[Claim 15] The direction of said V typeface slot is the train which said each pixel forms or claim 13 characterized by being equal to the direction of a line, and an organic electroluminescence display given [any 1] in 14.

[Claim 16] The core of the slot of said abbreviation V typeface that the pitch of each direction of said V typeface slot spreads the pitch of each direction of said light-emitting part corresponding to said each pixel, abbreviation, etc. is an organic electroluminescence display claim 13 characterized by being in the abbreviation midpoint which connects the core of each of said pixel - given [any 1] in 15.

[Claim 17] The pitch of each direction of said V typeface slot is an organic electroluminescence display claim 13 characterized by being smaller than the pitch of each direction of said light-emitting part corresponding to said each pixel - given [any 1] in 15.

[Claim 18] The area of the convex formed of said V typeface slot is an organic electroluminescence display claim 13 characterized by being smaller than the area of the luminous layer in said pixel - given [any 1] in 17.

[Claim 19] The distance to the convex formed of said V typeface slot from said luminous layer is an organic electroluminescence display claim 13 characterized by being smaller than die length of one side of said pixel - given [any 1] in 18.

[Claim 20] The include-angle conversion panel of said light is an organic electroluminescence display claim 13 characterized by coming to be divided more than for said every pixel - given [any 1] in 19.

[Claim 21] A sound signal conversion means to change voice into a sound signal, and an actuation means to input the telephone number etc., A display means to display an arrival-of-the-mail display, the telephone number, etc., and the means of communications which changes a sound signal into a sending signal, The personal digital assistant which are a receiving means to change an input signal into a sound signal, the antenna which transmit and receive said sending signal and said input signal, and a personal digital assistant equipped with the control means which controls each part, and is characterized by said display means consisting of displays claim 13 - given [any 1] in 20.

[Claim 22] The organic electroluminescent element characterized by being the organic electroluminescent element equipped with the luminous layer which has a luminescence field, having equipped one [said] electrode side with the substrate, and equipping inter-electrode [two] with the include-angle conversion panel of light at the electrode side of said another side.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the indicating equipment and personal digital assistant using the organic electroluminescent element used for the light emitting device used for the light source of various indicating equipments or an indicating equipment, a back light, or an optical-communication device, and it.

[0002]

[Description of the Prior Art] An electroluminescent element is a luminescence device using the electroluminescence of the solid-state fluorescence matter, the inorganic electroluminescent element using the current inorganic system ingredient as an illuminant is put in practical use, and application expansion to a back light, a flat display, etc. of a liquid crystal display is achieved partly. However, the electrical potential difference required in order to make light emit of an inorganic electroluminescent element is as high as more than 100V, and since blue luminescence is moreover difficult, full-color-izing by the three primary colors of RGB is difficult for it. Moreover, since an inorganic electroluminescent element has the very large refractive index of the ingredient used as an emitter, it is strongly influenced of the total reflection in an interface etc., the ejection effectiveness of the light to the inside of the air over actual luminescence is as low as about 10 - 20%, and efficient-izing is difficult for it.

[0003] On the other hand, although the research on the electroluminescent element using an organic material also attracted attention for many years and various examination had been performed, luminous efficiency did not progress to full-fledged utilization research from a very bad thing.

[0004] However, the organic electroluminescent element which will have the laminated structure of the functional discrete type which divided the organic material into two-layer [of an electron hole transportation layer and a luminous layer] by C.W.Tang and others of KODAKKU in 1987 was proposed, and it became clear that two or more 1000 cd/m high luminescence brightness is obtained in spite of the low battery not more than 10V [refer to C.W.Tang and S.A.Vanslyke:Appl.Phys.Lett and 51 (1987) 913 grade]. **** attention of the organic electroluminescent element begins to be carried out after this, research on the organic electroluminescent element which has the laminated structure of the same functional discrete type still now is done briskly, in order to be especially utilization of an organic electroluminescent element, examination is enough made also about indispensable efficient-izing and reinforcement, and the display using an organic electroluminescent element etc. is realized in recent years.

[0005] Here, the configuration of the conventional general organic electroluminescent element is explained using drawing 11 . Drawing 11 is the important section sectional view of the conventional organic electroluminescent element. For a substrate and 2, as for an electron hole transportation layer and 4, in drawing 11 , an anode plate and 3 are [1 / a luminous layer and 5] cathode.

[0006] As shown in drawing 11 , an organic electroluminescent element The anode plate 2 which consists of transparent conductive film, such as ITO formed by the sputtering method, resistance heating vacuum deposition, etc. on the substrate 1 which consists of glass etc., N formed by resistance heating vacuum deposition etc. the same on an anode plate 2, N'-diphenyl-N, the N'-screw (3-methylphenyl) -1, 1'-diphenyl - 4, 4'-diamine (it is hereafter called TPD for short.) etc. -- from -- 8-Hydroxyquinoline formed by resistance heating vacuum deposition etc. on the becoming electron hole transportation layer 3 and the electron hole transportation layer 3 With the luminous layer 4 which consists of Aluminum (it is hereafter called Alq3 for short.) etc. It has the cathode 5 which consists of a metal membrane of the 100nm - about 300nm thickness formed by resistance heating vacuum deposition etc. on the luminous layer 4.

[0007] When direct current voltage or a direct current is impressed by making cathode 5 into a minus pole,

using as a plus pole the anode plate 2 of the organic electroluminescent element which has the above-mentioned configuration, an electron hole is poured into a luminous layer 4 through the electron hole transportation layer 3 from an anode plate 2, and an electron is poured into a luminous layer 4 from cathode 5. In a luminous layer 4, the recombination of an electron hole and an electron arises, and in case the exciton generated in connection with this shifts to a ground state from an excitation state, luminescence happens.

[0008]

[Problem(s) to be Solved by the Invention] In such an organic electroluminescent element, outgoing radiation of the light emitted from the fluorescent substance in a luminous layer 4 is carried out to the omnidirection centering on a fluorescent substance, and it is usually emitted into air via the electron hole transportation layer 3, an anode plate 2, and a substrate 1. Or with the direction of optical ejection (substrate 1 direction), toward hard flow, it is reflected in cathode 5 and once emanates into air via a luminous layer 4, the electron hole transportation layer 3, an anode plate 2, and a substrate 1.

[0009] However, in case light passes through the interface of each medium, when the refractive index of the medium by the side of incidence is larger than the refractive index by the side of outgoing radiation, the light which carries out incidence at an include angle also with big the include angle from which the outgoing radiation angle of a refracted wave becomes 90 degrees, i.e., critical angle, and twist cannot penetrate an interface, but total reflection is carried out, and light is not taken out into air.

[0010] Here, the relation of the optical refraction angle in the interface of a different medium and the refractive index of a medium follows a Snell's law. According to the Snell's law, when light advances from the medium of a refractive index n_1 to the medium of a refractive index n_2 , the relation it is unrelated $n_1 \sin \theta_1 = n_2 \sin \theta_2$ between the incident angle θ_1 and angle of refraction θ_2 is realized. Therefore, when $n_1 > n_2$ are realized, incident angle $\theta_1 = \sin^{-1}(n_2/n_1)$ used as $\theta_2 = 90$ degree is well known as a critical angle, and when an incident angle is bigger than this, total reflection of the light will be carried out in the interface between media.

[0011] Therefore, in the organic electroluminescent element by which a light emission is carried out isotropic, the light emitted at a bigger include angle than this critical angle repeats the total reflection in an interface, is confined in the interior of a component, and is no longer emitted into air.

[0012] Drawing 12 is the mimetic diagram showing the typical beam-of-light path in the important section cross section of the conventional organic electroluminescent element. In addition, in drawing 12, the same sign is given to the same thing as the part explained by drawing 11.

[0013] As shown in drawing 12, in each interface, such as an interface (ITO / glass interface) of an anode plate 2 and a substrate 1, and an interface (glass / air interface) of a substrate 1 and air, total reflection of the light emitted out of the luminous layer 4 is carried out.

[0014] The light emitted in a luminous layer is not emitted to the component exterior, but this causes degradation on appearance as an organic electroluminescent element. Generally, as for the synchrotron orbital radiation obtained by the luminous layer of an organic electroluminescent element, most is confined in the interior of a component by total reflection, and it is known that being used as effective synchrotron orbital radiation is 17% to about 20% [refer to Advanced Material6 (1994) 491 grade].

[0015] Then, aiming at solution of the trouble mentioned above by establishing a means to change the outgoing radiation include angle of light into the substrate of an organic electroluminescent element is proposed.

[0016] For example, invention which raises optical ejection effectiveness by forming lens structure in the optical ejection side of a substrate is made by JP,2773720,B.

[0017] Moreover, invention which raises optical ejection effectiveness by forming a diffraction grating etc. in the location which controls the total reflection of a component interface is made by JP,2991183,B, and invention which raises optical ejection effectiveness by making a scattered reflection side, or reflection and angle of refraction produce turbulence for an optical ejection side front face is made by JP,9-129375,A at it.

[0018] Furthermore, it is forming a means changing whenever [light emission elevation], in a transparence substrate, or invention which raises optical ejection effectiveness is made by JP,10-308286,A by forming a light reflex layer in a lower electrode side face at JP,10-189251,A.

[0019] however, the above -- also in measure [which], since the measure which raises optical ejection effectiveness to a substrate top or the substrate itself is devised, the constraint in fields, such as a formation ingredient and an approach, is large. Since each pixel is small especially when using these improvement measures in optical ejection effectiveness for image formation equipments, such as a display, the degree of freedom to the improvement measure in optical ejection effectiveness is important.

[0020] This invention is made in view of the above-mentioned trouble, and aims at offering the display and

personal digital assistant using the organic electroluminescent element which can maintain the efficient luminescence engine performance, and it.

[0021]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, it is the organic electroluminescent element equipped with the anode plate which pours in an electron hole at least on a substrate, the luminous layer which has a luminescence field, and the cathode which pours in an electron, and considers as the configuration which comes to prepare the include-angle conversion panel of light for the component forming face side of a substrate.

[0022]

[Embodiment of the Invention] Invention according to claim 1 can maintain the efficient luminescence engine performance which it was the organic electroluminescent element equipped with the anode plate which pours in an electron hole at least on a substrate, the luminous layer which has a luminescence field, and the cathode which pours in an electron, was the organic electroluminescent element characterized by to have the include-angle conversion panel of light at the component forming face side of a substrate, and was excellent in visibility since the optical loss inside a component was able to be decreased.

[0023] It is the organic electroluminescent element characterized by invention according to claim 2 coming to stick the include-angle conversion panel of light on the protective coat formed in the organic electroluminescent element front face in claim 1, and since the optical loss inside a component can be decreased, the efficient luminescence engine performance excellent in visibility is maintainable.

[0024] In claims 1 and 2, the include-angle conversion panel of light is an organic electroluminescent element characterized by the optical ejection side consisting of the diffusing surface, and since invention according to claim 3 can decrease the optical loss inside a component, it can maintain the efficient luminescence engine performance excellent in visibility.

[0025] In claims 1-3, invention according to claim 4 is an organic electroluminescent element characterized by equipping the include-angle conversion panel of light with two or more slots parallel to the one direction of field inboard, and since the optical loss inside a component can be decreased, it can maintain the efficient luminescence engine performance excellent in visibility.

[0026] In claims 1-4, invention according to claim 5 is an organic electroluminescent element characterized by equipping the include-angle conversion panel of light with two or more slots parallel to the 2-way which intersects perpendicularly mutually [field inboard], and since the optical loss inside a component can be decreased, it can maintain the efficient luminescence engine performance excellent in visibility.

[0027] it be the organic electroluminescent element characterize by the slot where invention according to claim 6 be form in the include angle conversion panel of light in claims 1-5 be linear V typeface slot where the cross section configuration consist of a straight line which be two of abbreviation V typefaces , and since the optical loss inside a component can be decrease , the efficient luminescence engine performance excellent in visibility be maintainable .

[0028] it be the organic electroluminescent element characterize by the slot where invention according to claim 7 be form in the include angle conversion panel of light in claims 1-5 be rounded V typeface slot where the cross section configuration consist of a curve **** to the inside of an abbreviation V typeface , and since the optical loss inside a component can be decrease , the efficient luminescence engine performance excellent in visibility be maintainable .

[0029] It is the organic electroluminescent element characterized by the slot where invention according to claim 8 is formed in the include-angle conversion panel of light in claims 1-7 being a symmetrical configuration, and since the optical loss inside a component can be decreased, the efficient luminescence engine performance excellent in visibility is maintainable.

[0030] It is the organic electroluminescent element characterized by the slot where invention according to claim 9 is formed in the include-angle conversion panel of light in claims 1-7 being an unsymmetrical configuration, and since the optical loss inside a component can be decreased, the efficient luminescence engine performance excellent in visibility is maintainable.

[0031] It is the organic electroluminescent element characterized by the slot where invention according to claim 10 is formed in the include-angle conversion panel of light in claims 1-9 coming to form a light reflex side in the side face at least, and since the optical loss inside a component can be decreased, the efficient luminescence engine performance excellent in visibility is maintainable.

[0032] it be the organic electroluminescent element characterize by the slot where invention according to claim 11 be form in the include angle conversion panel of light in claims 1-9 come at least to form in the side face the field which consist of a medium with a refractive index smaller than an include angle change

panel, and since the optical loss inside a component can be decreased, the efficient luminescence engine performance excellent in a visibility be maintainable.

[0033] It is the organic electroluminescent element characterized by the coefficients of thermal expansion of the medium by which invention according to claim 12 forms the include-angle conversion panel of light in claims 1-11 being 80% or more of the coefficient of thermal expansion of a substrate, and less than 120%, and since the optical loss inside a component can be decreased, the efficient luminescence engine performance excellent in visibility is maintainable.

[0034] Invention according to claim 13 uses an organic electroluminescent element claim 1 - given [any 1] in 12. The direction of the slot which an anode plate is divided into an individual electrical-and-electric-equipment target in the shape of a stripe, and cathode is divided into an individual electrical-and-electric-equipment target in the shape of a stripe, is constituted, has an image display array, and is carved by the include-angle conversion panel of light. Since it is the organic electroluminescence display characterized by the direction of the pixel formed with one of stripe electrodes being the same and the optical loss inside a component can be decreased, The efficient luminescence engine performance can be maintained and a good display with a simple matrix method can be performed.

[0035] Invention according to claim 14 uses an organic electroluminescent element claim 1 - given [any 1] in 12. An anode plate, Either of the cathode is divided into an individual electrical-and-electric-equipment target for every pixel, and it is constituted and or the separated electrode By being scanned through at least one or more switching elements The direction of the slot which has an image display array with an image display array, and is carved by the include-angle conversion panel of light. Since it is the organic electroluminescence display characterized by **** characterized by the direction of a pixel being the same and the optical loss inside a component can be decreased, The efficient luminescence engine performance can be maintained and a good display with an active-matrix method can be performed.

[0036] In claims 13 and 14, the direction of said V typeface slot is the train which said each pixel forms, or an organic electroluminescence display characterized by being equal to the direction of a line, and since invention according to claim 15 can decrease the optical loss inside a component, it can maintain the efficient luminescence engine performance and can perform a good display.

[0037] Invention according to claim 16 is set to claims 13-15. The pitch of each direction of V typeface slot The pitch of each direction of the light-emitting part corresponding to each pixel, and the core of the slot of the abbreviation V typeface which spreads abbreviation etc. It is the organic electroluminescence display characterized by being in the abbreviation midpoint which connects the core of each pixel, and since the optical loss inside a component can be decreased, the efficient luminescence engine performance can be maintained and a good display can be performed.

[0038] In claims 13-15, the pitch of each direction of V typeface slot is an organic electroluminescence display characterized by being smaller than the pitch of each direction of the light-emitting part corresponding to each pixel, and since invention according to claim 17 can decrease the optical loss inside a component, it can maintain the efficient luminescence engine performance and can perform a good display.

[0039] The area of the convex in which invention according to claim 18 is formed of V typeface slot in claims 13-17 is an organic electroluminescence display characterized by being smaller than the area of the luminous layer in a pixel, since the optical loss inside a component can be decreased, can maintain the efficient luminescence engine performance and can perform a good display.

[0040] The distance to the convex in which invention according to claim 19 is formed of V typeface slot from a luminous layer in claims 13-18 is an organic electroluminescence display characterized by being smaller than die length of one side of a pixel, since the optical loss inside a component can be decreased, can maintain the efficient luminescence engine performance and can perform a good display.

[0041] In claims 13-19, invention according to claim 20 is an organic electroluminescence display characterized by the ability to divide the include-angle conversion panel of light more than for every pixel, since the optical loss inside a component can be decreased, can maintain the efficient luminescence engine performance and can perform a good display.

[0042] A sound signal conversion means by which invention according to claim 21 changes voice into a sound signal, An actuation means to input the telephone number etc., and a display means to display an arrival-of-the-mail display, the telephone number, etc., The means of communications which changes a sound signal into a sending signal, and a receiving means to change an input signal into a sound signal, They are the antenna which transmits and receives a sending signal and an input signal, and the personal digital assistant equipped with the control means which controls each part. Since it is the personal digital assistant characterized by a display means consisting of displays claim 13 - given [any 1] in 20 and the optical loss

inside a component can be decreased, The efficient luminescence engine performance can be maintained and lightweight-izing or the formation of a long time by streamlining of cell capacity etc. can be attained. [0043] Invention according to claim 22 is the organic electroluminescent element which equipped inter-electrode [two] with the luminous layer which has a luminescence field, is an organic electroluminescent element characterized by having equipped one electrode side with the substrate and equipping the electrode side of another side with the include-angle conversion panel of light, and since the optical loss inside a component can be decreased, it can maintain the efficient luminescence engine performance excellent in visibility.

[0044] Hereafter, the organic electroluminescent element of this invention is explained to a detail.

[0045] First, the function of the include-angle conversion panel of light is explained.

[0046] As mentioned above, in the organic electroluminescent element to which the light emission of the relation of the optical refraction angle in the interface of a different medium and the refractive index of a medium is carried out isotropic according to a Snell's law, the light emitted at a bigger include angle than a critical angle repeats the total reflection in an interface, is confined in the interior of a component, and is no longer emitted into air.

[0047] Therefore, it is important for improvement in effectiveness of an organic electroluminescent element to change the include angle and amount of the light which changes the include angle of the light which reaches an optical ejection side / air interface, and is emitted into air by changing the include angle of light using a means to change the include angle of the light in an interface.

[0048] In addition, although structures, such as lens structure, concavo-convex structure, prism structure, etc. on a substrate, are proposed as an include-angle conversion means of light When forming such structures in a substrate side, the support capacity as a substrate is maintained. The constraint to the ingredient and the formation approach which needs to form the structure designed suitably and is used for the structure arises, or Moreover, since the constraint to the formation approaches, such as a luminous layer, etc. arises from the need of forming a luminous layer, without the structure's being in the substrate upper part and giving a damage to the structure, implementation is difficult. Especially the thing for which the display which used the organic electroluminescent element for this structure is formed is difficult, for example, in the case of a simple matrix display, it is very difficult to form the electrode which counters a substrate in the shape of a strip of paper on the substrate with which the structure was formed.

[0049] On the other hand, by the organic electroluminescent element in this invention, the organic electroluminescence light-emitting part which consisted of components, such as an anode plate formed on the substrate, a luminous layer, and cathode, and the include-angle conversion panels of light including a substrate are created separately, and include-angle conversion of light can be realized by joining both, without receiving various constraint to each of the include-angle conversion panel of the organic electroluminescent element section and light.

[0050] Such an include-angle conversion panel of light gives refractive-index distribution to the interior of the configuration which has arranged structures, such as lens structure and concavo-convex structure, and prism structure, in a panel side, or a panel, and can consider the configuration to which the include angle of light is transformed.

[0051] Also in these, a production process is easy and the include-angle conversion panel of the light which uses a monotonous panel as a base material as a configuration which has effectiveness in the improvement in ejection effectiveness of light, and has two or more slots parallel to the one direction of the field inboard is effective. By using the include-angle conversion panel of the light of such a configuration, efficient optical ejection is realizable. Here, drawing 1 is drawing showing an example of the include-angle conversion panel of the light in the gestalt of operation of this invention, drawing 1 (a) shows a top-face perspective view, and drawing 1 (b) shows the inferior-surface-of-tongue perspective view, respectively. In drawing 1 , 6 shows the include-angle conversion panel of light, and 7 shows a slot. As shown in drawing 1 , the include-angle conversion panel 6 of light uses a monotonous panel as a base material, and has two or more slots 7 parallel to the one direction of the field inboard.

[0052] Moreover, in order to perform include-angle conversion of light only about one direction in the case of the panel which has two or more slots parallel to one direction, it is difficult to perform include-angle conversion of an effective light. Therefore, a monotonous panel is used as a base material, and by using the include-angle conversion panel of the light which has two or more slots parallel to the 2-way which intersects perpendicularly mutually within the field, a production process is easy and can realize very efficient optical ejection. Here, drawing 2 is drawing showing an example of the include-angle conversion panel of the light in the gestalt of operation of this invention, drawing 2 (a) shows a top-face perspective

view, and drawing 2 (b) shows the inferior-surface-of-tongue perspective view, respectively. As shown in drawing 2, the include-angle conversion panel 6 of light uses a monotonous panel as a base material, and has two or more slots 7 parallel to the 2-way which intersects perpendicularly mutually within the field. [0053] Moreover, although you may be which configuration as long as the slot formed in the include-angle conversion panel of light is a configuration including the field which is not parallel to a panel side at least, as for the slot formed in the include-angle conversion panel of light from viewpoints over the ease and the optical ejection of a production process, such as an ease of a design, it is desirable that it is linear V typeface slot where the cross-section configuration consists of a straight line which is two of abbreviation V typefaces. Here, drawing 3 is drawing showing the cross-section configuration of the slot formed in the include-angle conversion panel of the light in the gestalt of operation of this invention. As shown in drawing 3, a slot 7 is an abbreviation V typeface and serves as linear V typeface.

[0054] The slot form in the include angle conversion panel of light in order to raise optical ejection effectiveness further have the desirable cross section configuration which can design the orientation of light freely so that the luminous intensity of the direction of a transverse plane may become strong, and it be desirable that it be rounded V typeface slot which become the inside of an abbreviation V typeface from two **** curves so that light can be efficiently take out according to the include angle of the light which arrive at a side face. Here, drawing 4 is drawing showing the cross-section configuration of the slot formed in the include-angle conversion panel of the light in the gestalt of operation of this invention, and 8 shows a slot. As shown in drawing 4, a slot 8 is an abbreviation V typeface, and while it is rounded, it serves as **** V typeface.

[0055] In addition, it may be the cross-section configuration of the slot which consists of the 2nd page which has a relation [**** / un-] to a panel side, and a panel side, and the abbreviation V typeface in this invention is carrying out the abbreviation triangle-like configuration, and may have the shape of an abbreviation triangle from which the top-most-vertices part became field configurations, such as a flat surface or a curved surface. With linear V typeface slot, moreover, the 2nd page which has a relation [**** / un-] to a panel side With rounded V typeface slot where the cross-section configuration characterized by consisting of a flat surface is the thing of the slot which is the above-mentioned abbreviation V typeface, and consists of a **** curve inside The cross-section configuration characterized by the 2nd page which has a relation [**** / un-] to a panel side consisting of curved surfaces where the cross-section configuration serves as a convex inside an abbreviation triangle is the thing of the slot which is the above-mentioned abbreviation V typeface.

[0056] The light which inclined by preparing the include-angle conversion panel of such a light to a luminescence side which is confine in the interior of a component by total reflection also especially in the light emit from a luminous layer can change an include angle by the total reflection in the panel / air interface of V typeface slot on the panel, it will be take out into air, and the ejection effectiveness of light and the luminous intensity of the direction of a transverse plane become strong. That is, since include-angle conversion of light is not performed about the light by which total reflection is carried out before reaching the include-angle conversion panel of light, as for light, it is desirable not to go via a layer with a low refractive index, by the time not going via an air space by the time it reaches the include-angle conversion panel of light from a luminous layer reaches desirable still more preferably.

[0057] Although it cannot be overemphasized that its attention is paid about the drawing effectiveness of the light which has direct influence on the effectiveness of an organic electroluminescent element when forming the include-angle conversion panel of such a light Since it is necessary to pay one's attention about the contrast at the time of using for component effectiveness and coincidence as a component life or a display device, It is necessary to mind also about the point of distance with a conversion means whenever [touch-area / of an organic electroluminescence light-emitting part and the include-angle conversion means of light /, or organic electroluminescence light-emitting part and optic angle].

[0058] When joining the include-angle conversion panel of light to image display devices, such as a display using an organic electroluminescent element, it is important to use effectively the light emitted from a pixel, if the direction which is a pixel, and the direction of V typeface slot are made in agreement, V typeface slot can be arranged without decreasing the light-emitting part area in a pixel, and the include-angle conversion effectiveness of an efficient light can be performed.

[0059] Here, drawing 5 is the important section sectional view of the organic electroluminescent element in the gestalt of operation of this invention. In drawing 5, since a substrate 1, an anode plate 2, the electron hole transportation layer 3, a luminous layer 4, and cathode 5 are the same as that of what was explained by the Prior art, the same sign is attached and explanation is omitted. In addition, 6 is the include-angle

conversion panel of light, and 7 is a slot.

[0060] As shown in drawing 5, the pitch of each direction of V typeface slot 7 is made equal to the pitch of each direction of the light-emitting part corresponding to each pixel, and physical relationship of a light-emitting part and V typeface slot 7 can be made the same by making the core of the abbreviation V typeface slot 7 be in the abbreviation midpoint which connects the core of each pixel, the same improvement effectiveness in ejection effectiveness is acquired in every pixel, and a good image can be obtained.

[0061] Furthermore, drawing 6 is the important section sectional view of the organic electroluminescent element in the gestalt of operation of this invention.

[0062] Drawing 6 By making the pitch of each direction of V typeface slot 7 smaller than the pitch of each direction of the light-emitting part corresponding to each pixel, two or more V typeface slots 7 can be formed in a light-emitting part, it is not necessary to carry out strict alignment, physical relationship of a light-emitting part and V typeface slot 7 can be made the same, the same improvement effectiveness in ejection effectiveness is acquired in every pixel, and a good image can be obtained so that it may be shown.

[0063] Furthermore, drawing 7 is the important section sectional view of the organic electroluminescent element in the gestalt of operation of this invention.

[0064] An alignment process also becomes easy, while being able to enlarge magnitude of V typeface slot 7 and being able to form a panel easily by making the pitch of each direction of V typeface slot 7 larger than the pitch of each direction of the light-emitting part corresponding to each pixel, as shown in drawing 7.

[0065] Moreover, when the organic electroluminescent element which formed the include-angle conversion panel of light on the substrate as image formation equipments, such as a display, is used, The light emitted from the pixel of arbitration may reach to the include-angle conversion panel of the light which will have been arranged in another pixel by the time it reached the include-angle conversion panel of light, may cause [which is emitted into air] the so-called stray light from the pixel, and may bring about faults, such as a fall of contrast, and an optical blot, dotage.

[0066] Then, the fully thin thing of the thickness from a luminous layer to the include-angle conversion panel of light is desirable, as for the distance to the convex formed of V typeface slot from a luminous layer, it is desirable that it is smaller than die length of one side of a pixel, and, thereby, effect of the stray light can be made small.

[0067] Furthermore, in order to carry out reinforcement of the organic electroluminescent element, it is effective to enlarge area of the light-emitting part to the magnitude of a pixel. However, since the area of the convex formed of V typeface slot becomes small to a pixel when performing include-angle conversion of the light by V typeface slot, it is disadvantageous to the reinforcement of a component to make the same area of this convex and area of the luminous layer in a pixel. Therefore, an efficient and long lasting organic electroluminescent element is realizable by making smaller than the area of the luminous layer in a pixel area of the convex formed of V typeface slot.

[0068] Moreover, when using an organic electroluminescent element as lighting systems, such as displays, such as a display, and the printer light source, the design about the above-mentioned orientation of light becomes important. for example, the case where it uses as a display of a personal digital assistant or a cash dispenser -- the display condition -- a user -- the lower one of the visibility from a perimeter is [that only he recognizes] desirable. Moreover, since it is called for that a light strong only against the part of the photo conductor corresponding to opening can be irradiated when using as the printer light source, it is [that there should just be brightness from opening to the direction of a transverse plane] desirable that there are few light emissions to the direction of the circumference. In such a case, the thing strong against the direction of an abbreviation transverse plane of the light emitted from opening weakly emitted in the direction of a perimeter is desirable, and it is desirable that directive optical high ejection is made.

[0069] Moreover, when using for example, as a display for two or more men, such as television and an advertising application display, as for the display condition, it is desirable like the visibility of the direction of a transverse plane that the visibility from a perimeter is high. Moreover, when using as the light source of indoor lighting etc., it is desirable that light is uniformly irradiated for lighting. When above, as for the light emitted from opening, emanating in all the directions uniformly is desirable, and it is desirable that uniform optical ejection without directivity is made.

[0070] When the include-angle conversion panel of the light in this invention etc. is used, by making the cross-section configuration of V typeface slot into a symmetrical configuration, directivity strong against the direction of a transverse plane can be given for the orientation of light, or the orientation of an equivalent light can be designed to all pixels. Moreover, it is possible to also make light emit isotropic by being able to change the direction of orientation of light by making the cross-section configuration of V typeface slot into

an unsymmetrical configuration, and being able to design orientation according to arrangement of a pixel, such as a periphery and a core, or arranging the cross-section configuration of V typeface slot asymmetrically and at random. Furthermore, it is possible to be able to scatter the light taken out, to be able to make orientation of light uniform, and to also make light emit isotropic by making the optical ejection side of the include-angle conversion panel of light into the diffusing surface.

[0071] The organic electroluminescence element which can maintain the efficient luminescence engine performance which can perform reinforcement by being able to design vision properties, such as orientation of light, and increasing luminescence area by considering as the include-angle conversion panel of the light of the above configurations is realizable.

[0072] Furthermore, when joining the include-angle conversion panel of light and a direct panel join on a transparent electrode, and affect the life and the effectiveness of an organic electroluminescent element under the effect of the moisture contain in the binder to join, for example, or reactant gas, or a transparent electrode exfoliate from a luminous layer because the force join a panel the time of junction, and after junction, or inter-electrode connect too hastily, the fault of a component stopping emitting light etc. may arise.

[0073] Then, the protective coat for easing a damage is formed on a transparent electrode, and efficient luminescence can be realized by sticking the include-angle conversion panel of light on the top face, without producing the above-mentioned fault.

[0074] Moreover, when joining using binding material to which the include-angle conversion panel of light is made as for optical association, such as liquefied media, such as adhesives and optical joint liquid, binding material may enter the interior of V typeface slot. The rate that binding material enters becomes large for the reasons of being hard coming to apply or becoming easy to discover capillarity of binding material as the pitch of V typeface slot becomes small especially.

[0075] In addition, in order for light to prevent carrying out total reflection before carrying out incidence to the include-angle conversion panel of light, as optical binding material was described above, the include-angle conversion panel of light and the ingredient of refractive index about the same as the refractive index of a luminous layer are used. If the ingredient of such a refractive index enters the interior of V typeface slot, the include-angle conversion effectiveness of the light in V typeface slot will become small. In order to reduce such effect, it is effective to save the path of the light in the side face of V typeface slot, and efficient luminescence can be realized by forming the field which forms a light reflex side in the side face of V typeface slot, or turns into a side face of V typeface slot from a medium with a refractive index smaller than an include-angle conversion panel.

[0076] When the include-angle conversion panel of light differs from the ingredient of a substrate, the thermal expansion of each part material may become a problem. That is, in the practical use temperature requirement of an organic electroluminescent element, by thermal expansion, the evil of the attachment section of the include-angle conversion panel of light exfoliating arises because the magnitude of the include-angle conversion panel of light and a substrate changes. Therefore, in order to control the evil by these thermal expansion, it is important to carry out near of the value of the coefficient of thermal expansion of the include-angle conversion panel of light and the coefficient of thermal expansion of a substrate as much as possible, and, as for the coefficient of thermal expansion of the medium which forms the include-angle conversion panel of light, it is desirable that they are 80% or more of the coefficient of thermal expansion of a substrate and less than 120%. Furthermore, it is desirable that the include-angle conversion panel of light is not formed as a panel of one, but can be divided more than for every pixel.

[0077] The organic electroluminescence element which can join easily and can maintain the efficient luminescence engine performance by considering as the include-angle conversion panel of the light of the above configurations is realizable.

[0078] Next, each configuration section which constitutes the organic electroluminescent element of this invention is explained.

[0079] First, a substrate is explained. Since the substrate of the organic electroluminescent element of this invention does not use as an ejection side of light, transparency or opacity, and any substrate can be used for it, and there should just be [reinforcement which can hold an organic electroluminescent element]. In addition, in this invention, transparency or a translucent definition shows the transparency of extent which does not bar a check by looking of luminescence by the organic electroluminescent element.

[0080] A substrate For example, transparency or translucent soda lime glass, barium strontium content glass, inorganic glass, such as inorganic oxide glass, such as lead glass, aluminosilicate glass, borosilicate glass, barium borosilicate glass, and quartz glass, and inorganic fluoride glass, -- or Transparency or translucent

polyethylene terephthalate, a polycarbonate, Pori polymethylmethacrylate, polyether sulfone, vinyl fluoride high polymer films, such as polypropylene, polyethylene, polyacrylate, amorphous polyolefine, and fluororesin, etc. -- or cull KOGENO of transparence or As₂S₃ [translucent], As₄₀S₁₀, and S₄₀germanium₁₀ grade -- the id -- glass -- ZnO, Nb₂O₅, Ta₂O₅, and SiO and Si₃ -- ingredients, such as a metallic oxide of N₄, HfO₂, and TiO₂ grade, and a nitride, -- or semiconductor materials, such as opaque silicon, germanium, carbonization silicon, gallium arsenide, and gallium nitride, -- or It can choose from said transparence substrate ingredient containing a pigment etc., the metallic material which performed insulating processing to the front face suitably, and can use, and the laminated circuit board which carried out the laminating of two or more substrate ingredients can also be used.

[0081] Moreover, the circuit which consists of resistance, a capacitor inductor diode transistor, etc. for driving an organic electroluminescent element may be formed in the interior of this substrate front face or a substrate.

[0082] Next, the include-angle conversion panel of light is explained. As for the include-angle conversion panel of light, it is desirable to consist of an ingredient which can take out efficiently the light which can choose from the ingredient of transparence or a translucent substrate suitably among said substrate ingredients, can use, and is emitted from a luminous layer, and what has easy formation is desirable in the structure of V typeface slot etc. on a panel front face. Moreover, the approach of forming the include-angle conversion panel of said light with formation, then shaping which was said can be used with said secondary metal mold by forming V typeface slot in metal mold with for example, the approach of using the processing tool of a cutting tool or a grinding stone for said substrate ingredient, and forming V typeface slot directly as the formation approach of V typeface slot, and the aforementioned processing tool, and imprinting it to secondary metal mold between the colds and by hot working.

[0083] As a member which sticks the include-angle conversion panel of light, it is desirable that can carry out optical association between transparence or the optical ejection layer before are translucent and sticking a panel, and a panel, and the total reflection of light does not arise between optical ejection layers. As an ingredient of an attachment member, it can choose suitably from the charges of optical binding material of a non-hardening mold called optical joint liquid, such as a charge of optical binding material of hardening molds, such as a transparence resist and transparence optical adhesives, or ethylene glycol, and can use. In order to use the effectiveness of the include-angle conversion panel of light effectively, it is desirable to choose a panel or an ingredient with a refractive index higher than a luminous layer.

[0084] An anode plate is an electrode which pours in an electron hole, and needs to inject an electron hole into a luminous layer or an electron hole transportation layer efficiently. A transparent electrode can be used as an anode plate. As an ingredient of a transparent electrode, metallic oxides, such as an indium stannic-acid ghost (ITO), tin oxide (SnO₂), and a zinc oxide (ZnO), Or the transparence electric conduction film which consists of mixture, such as SnO:Sb (antimony) and ZnO:aluminum (aluminum), or metal thin films, such as a metal thin film called aluminum (aluminum), Cu (copper), Ti (titanium), and Ag (silver) of the thickness of extent which does not spoil transparency, a mixed thin film of these metals, and a laminating thin film, -- or conductive polymers, such as polypyrrole, etc. can be used. Moreover, it is also possible to use two or more above-mentioned transparent electrode ingredients as a transparent electrode by carrying out a laminating, and it forms by various kinds of polymerization methods, such as resistance heating vacuum evaporation, electron beam evaporation, a spatter, or an electric-field polymerization method, etc. Moreover, in order to give sufficient conductivity, or in order to prevent ununiformity luminescence by the irregularity on the front face of a substrate, as for a transparent electrode, it is desirable to make it the thickness of 1nm or more. Moreover, in order to give sufficient transparency, it is desirable to make it the thickness of 500nm or less.

[0085] Furthermore, as an anode plate, the big metal of work functions, such as Cr (chromium), nickel (nickel), Cu (copper), Sn (tin), W (tungsten), and Au(gold), or its alloy, an oxide, etc. can be used besides these transparent electrodes, and the laminated structure by two or more ingredients which used these anode materials can also be used. However, when not using a transparent electrode as an anode plate, in order to make the most of the effectiveness of the include-angle conversion means of light, as for an anode plate, forming with the ingredient which reflects light is desirable. In addition, cathode should just be a transparent electrode when not using a transparent electrode as an anode plate.

[0086] Moreover, the amorphous carbon film may be prepared in an anode plate. In this case, it both has a function as a hole-injection electrode. That is, an electron hole is injected into a luminous layer or an electron hole transportation layer through the amorphous carbon film from an anode plate. Moreover, a spatter comes to form the amorphous carbon film between an anode plate, a luminous layer, or an electron

hole transportation layer. Although there are isotropic graphite, anisotropy graphite, glassy carbon, etc. and it does not limit especially as a carbon target by sputtering, isotropic graphite with high purity is suitable. If the point that the amorphous carbon film is excellent is shown concretely, when the work function of the amorphous carbon film will be measured using Riken Keiki 1 [surface analysis equipment AC-], the work function of the amorphous carbon film is $WC=5.40\text{eV}$. Here, since the work function of ITO generally well used as an anode plate is $WITO=5.05\text{eV}$, it can pour in an electron hole having used the amorphous carbon film efficiently [direction] in a luminous layer or an electron hole transportation layer. Moreover, in case the amorphous carbon film is formed by the sputtering method, in order to control the electric resistance value of the amorphous carbon film, reactive sputtering is carried out under the mixed-gas ambient atmosphere of nitrogen or hydrogen, and an argon. Furthermore, in the thin film coating technology by the sputtering method etc., if thickness is set to 5nm or less, the film will serve as island-shape structure and the homogeneous film will not be obtained. Therefore, by 5nm or less, efficient luminescence is not obtained for the thickness of the amorphous carbon film, and effectiveness of the amorphous carbon film cannot be expected. When thickness of the amorphous carbon film is set to 200nm or more, a membranous color wears a blacking wash and luminescence of an organic electroluminescent element stops moreover, fully penetrating.

[0087] Moreover, as for a luminous layer ingredient, what has a fluorescence property in a visible region, and consists of a good fluorescent substance of membrane formation nature is desirable. Besides Alq3 or Be-benzoquinolinol (BeBq2), it is 2 and 5-screw (5, 7-G t-pentyl-2-benzoxazolyl). - 1, 3, 4-thiadiazole, A 4 and 4'-bis(5, 7-pentyl-2-benzoxazolyl) stilbene, 4 and 4' bis[-] [5 and 7-G (2-methyl-2-butyl)-2-benzoxazolyl] stilbene, 2, a 5-bis(5, 7-G t-Ben Chill-2-benzoxazolyl) thiophene, 2, a 5-bis([5-alpha and alpha-dimethylbenzyl]-2-benzoxazolyl) thiophene, 2, 5-screw [5 and 7-G (2-methyl-2-butyl)-2-benzoxazolyl]-3, 4-diphenyl thiophene, 2, a 5-bis(5-methyl-2-benzoxazolyl) thiophene, A 4 and 4'-bis(2-benzoOKISAIZORIRU) biphenyl, 5-methyl-2-[2-[4-(5-methyl-2-benzoOKISAIZORIRU) phenyl] vinyl] benzoOKISAIZORIRU, Benzooxazole systems, such as 2-[2-(4-chlorophenyl) vinyl] [1 and 2-naphth d] oxazole, 2 2' -(p-phenylenedivinylene)- Benzothiazole systems, such as screw benzothiazole, 2-[2-[4-(2-benzoimidazolyl) phenyl] vinyl] benzimidazole, Fluorescent brighteners, such as benzimidazole systems, such as 2-[2-(4-carboxyphenyl) vinyl] benzimidazole, Bis(eight quinolinol) magnesium, bis(benzo-eight quinolinol) zinc, Bis(2-methyl-8-quinolate) aluminum oxide, a tris (eight quinolinol) indium, Tris (5-methyl-eight quinolinol) aluminum, an eight-quinolinol lithium, A tris (5-chloro-eight quinolinol) gallium, bis(5-chloro-eight quinolinol) calcium, Metal chelation oxy-NOIDO compounds, such as 8-hydroxyquinoline system metal complexes, such as Pori [zinc-bis(8-hydroxy-5-KINORI nonyl) methane], and dilithium EPINDORI dione, 1, 4-bis(2-methyl styryl) benzene, 1, 4-(3-methyl styryl) benzene, 1, 4-bis(4-methyl styryl) benzene, JISUCHIRIRU benzene, 1, 4-bis(2-ethyl styryl) benzene, 1, 4-bis(3-ethyl styryl) benzene, Styryl benzenoid compounds, such as 1 and 4-bis(2-methyl styryl) 2-methylbenzene, 2, 5-bis(4-methyl styryl) pyrazine, 2, 5-bis(4-ethyl styryl) pyrazine, 2 and 5-bis[2-(1-naphthyl) vinyl] pyrazine, 2, 5-bis(4-methoxy styryl) pyrazine, JISUCHIRU pyrazine derivatives, such as 2 and 5-bis[2-(4-biphenyl) vinyl] pyrazine, 2, and 5-bis[2-(1-pyrenyl) vinyl] pyrazine, The North America Free Trade Agreement RUIMIDO derivative, a perylene derivative, an OKISA diazole derivative, an aldazine derivative, a cyclopentadiene derivative, a styryl amine derivative, a coumarin system derivative, an aromatic series JIMECHIRI DIN derivative, etc. are used. Furthermore, an anthracene, salicylate, a pyrene, coronene, etc. are used. Or phosphorescence luminescent material, such as FAKU-tris (2-phenyl pyridine) iridium, may be used.

[0088] Moreover, which structure of the two-layer structure of an electron hole transportation layer, a luminous layer or a luminous layer, and an electronic transportation layer and the three-tiered structure of an electron hole transportation layer, a luminous layer, and an electronic transportation layer is sufficient besides the monolayer structure of only a luminous layer. however -- the case of such a two-layer structure or a three-tiered structure -- an electron hole transportation layer and an anode plate -- or a laminating is carried out and it is formed so that cathode may touch an electronic transportation layer.

[0089] And as an electron hole transportation layer, hole mobility is high, it is transparent and the good thing of membrane formation nature is desirable. Besides TPD, porphin, tetraphenylporphine copper, a phthalocyanine, Porphyrin compounds, such as a copper phthalocyanine and titanium phthalocyanine oxide, A 1 and 1-bis{4-(G P-tolylamino) phenyl} cyclohexane, 4, 4', a 4"-trimethyl triphenylamine, N and N, N', N'-tetrakis (P-tolyl)-P-phenylenediamine, 1-(N and N-G P-tolylamino) naphthalene, 4, a 4 'bis[- / -2-2] (dimethylamino)'-dimethyl triphenylmethane color, N, N, N', and N' -- the - tetra-phenyl -4 and 4' - diamino biphenyl -- N, N'-diphenyl-N, the N'-G m-tolyl -4, N, N-diphenyl-N, the N'-screw (3-methylphenyl) -1, 1' - 4 4'-diamine, Aromatic series tertiary amines, such as a 4'-diamino biphenyl and N-phenyl carbazole,

Stilbene compounds, such as a 4-G P-tolylamino stilbene and 4-(G P-tolylamino)-4'-[4-(G P-tolylamino) styryl] stilbene, A triazole derivative, an OKISAJIZAZORU derivative, and an imidazole derivative, The poly aryl alkane derivative, a pyrazoline derivative, and a pyrazolone derivative, A phenylenediamine derivative, an annealing amine derivative, and an amino permutation chalcone derivative, an oxazole derivative, a styryl anthracene derivative, and full -- me -- non -- a derivative -- A hydrazone derivative, a silazane derivative, a polysilane system aniline system copolymer, giant-molecule oligomer, a styryl amine compound, an aromatic series JIMECHIRI DIN system compound, and organic materials, such as Pori 3-methylthiophene, are used. Moreover, the electron hole transportation layer of the macromolecule dispersed system which distributed the organic material for low-molecular electron hole transportation layers is also used into macromolecules, such as a polycarbonate.

[0090] Moreover, as an electronic transportation layer, OKISA diazole derivatives, such as 1 and 3-bis(4-tert-butylphenyl - 1, 3, 4-oxadiazolyl) phenylene (OXD-7), an anthra quinodimethan derivative, a diphenyl quinone derivative, etc. are used.

[0091] Cathode is an electrode which pours in an electron, and needs to inject an electron into a luminous layer or an electronic transportation layer efficiently, and, generally the oxide of metals, such as aluminum (aluminum), In (indium), Mg (magnesium), Ti (titanium), Ag (silver), calcium (calcium), Sr (strontium), etc. with a small work function, or these metals, a fluoride and its alloy, a layered product, etc. are used. And in order to make the most of the effectiveness of include-angle conversion of light, as for cathode, forming with the ingredient which reflects light is desirable.

[0092] When the include-angle conversion panel of light is stuck, it is difficult to perform effective include-angle conversion to all light, therefore total reflection of the light which was not taken out by include-angle conversion of a one-time light is carried out by the interface with air, it is again spread inside a component, and reaches to cathode. Or in a luminous layer, since light is emitted isotropic, one half reaches to cathode among the light emitted by the luminous layer, before arriving at an optical ejection side. When formed with the ingredient with which cathode reflects light at this time, it is reflected, and the light which reached to this cathode becomes again possible [spreading in the direction of an optical drawing side], and may be used as an effective light. In order to confirm this effectiveness, as for cathode, forming with the ingredient which reflects light is desirable, and it is still more desirable that the reflection factor of light is 50% or more. Since the rate of the improvement in effectiveness by include-angle conversion of light is about 2 times, if the loss of light [in / in the reflection factor of light / 50% or more, i.e., cathode,] is 50% or less, effective optical drawing is possible for this. Although it was required in the conventional organic electroluminescent element that the reflection factor of cathode should have been very high, when optical ejection effectiveness improves, it is also possible to expand selectivity, such as an ingredient of cathode, thickness, and the formation approach. In addition, when cathode is used for the above thing as a transparent electrode, it cannot be overemphasized that it is applied to an anode plate.

[0093] Or in order to control the fall of the contrast by outdoor daylight called the sunlight and fluorescent lamp which carry out incidence from the optical ejection side of an organic electroluminescent element, it is effective to use the electrode of either an anode plate or cathode as the electrode which absorbs light.

[0094] Moreover, as cathode, it is forming the high super-thin film of the light transmission nature which used the small metal of a work function for the interface which touches a luminous layer or an electronic transportation layer, and carrying out the laminating of the transparent electrode in the upper part, and it is also possible to form transparence cathode. Laminated structures, such as LiO₂/aluminum, such as small Mg of especially a work function, a Mg-Ag alloy, an aluminum-Li alloy given in JP,5-121172,A and a Sr-Mg alloy or an aluminum-Sr alloy, and an aluminum-Ba alloy, or LiF/aluminum, are suitable as a cathode material.

[0095] Furthermore, as the membrane formation approach of these cathode, resistance heating vacuum evaporation, electron beam evaporation, and a spatter are used.

[0096] In addition, at least one side of an anode plate and cathode should just be a transparent electrode. Furthermore, although you may be both transparent electrodes, if one side is a transparent electrode in order to raise the ejection effectiveness of light, it is desirable that another side forms with the ingredient which reflects light.

[0097] Moreover, a protective coat may be formed in a component front face, in order to intercept an organic electroluminescent element from the open air and to guarantee long duration stability. The polymeric materials of a silane system with the resin of the glass membrane which consists of those mixture, such as a thin film which consists of inorganic oxides, such as SiON, SiO, SiN and SiO₂, aluminum₂O₃, and LiF, an inorganic nitride, and an inorganic fluoride or an inorganic oxide, an inorganic nitride, and an

inorganic fluoride, etc. as an ingredient of a protective coat or thermosetting, and a photoresist, or the closure effectiveness etc. are mentioned, and it is formed by the applying or method, such as vacuum evaporation and sputtering.

[0098] Moreover, the organic electroluminescent element of this invention can be used as a display which displays an image, and these displays can be used for the display of AV equipments, such as a display of the display of Personal Digital Assistants, such as a cellular phone, and PHS, PDA, television, a personal computer, car navigation, etc., a stereo, and radio, etc.

[0099] Furthermore, it can use for the lighting system as the light source of a laser beam printer, a scanner, etc. Or it can also use as a lighting system as the mere light source like lighting fitting, such as a tonneau light and the right stand.

[0100] It is desirable to use for the lighting system as the light source of the display as a display which will display an image in various electronic equipment also in these if a predominance, like ease [the low power of an organic electroluminescent element and the formation of a lightweight thin shape] and a speed of response are quick is taken into consideration, a laser beam printer, a scanner, etc., etc.

[0101] The gestalt of operation of this invention is explained below.

[0102] (Gestalt 1 of operation) The organic electroluminescent element in the gestalt of operation of this invention is described. In addition, here explains using drawing 5.

[0103] The organic electroluminescent element in the gestalt of this operation is equipped with the include-angle conversion panel 6 of light by which V typeface slot 7 was formed in the component side front face of a substrate 1 as an improvement means in ejection effectiveness of light. And it is desirable that the include-angle conversion panel 6 of the light changes the include angle of the light emitted from a luminous layer 4 into an include angle smaller than the critical angle which causes total reflection in the interface of an optical ejection side and air. It can choose suitably and the component of the include-angle conversion panel of light and the formation approach can be used so that drawing of luminescence from [out of the component mentioned above, and the formation approach or a conventionally well-known ingredient] a luminous layer 4 may not be barred.

[0104] In addition, the component of a substrate 1, an anode plate 2, the electron hole transportation layer 3, a luminous layer 4, and cathode 5, the component which also mentioned the formation approach above, the formation approach, and a well-known thing can be used conventionally.

[0105] Furthermore, in the gestalt of this operation, although the case of the two-layer structure which consists of an electron hole transportation layer 3 and a luminous layer 4 was explained, especially about the structure, it is not limited to this as mentioned above.

[0106] Moreover, in the gestalt of this operation, although the case of the structure which forms an anode plate 2 in substrate 1 top face was explained, it is also possible for it not to be limited to this as mentioned above especially about the structure, and to form cathode 5 in substrate 1 top face.

[0107] Moreover, about the gestalt of the closure, as an optical ejection side and a glass cap cannot stick, a glass cap can be realized by pasting a substrate with UV hardening resin etc., or forming and closing a protective coat on the front face of an organic electroluminescent element etc. can adopt a means suitably. Even if it is otherwise the combination of a protective coat, shielding material, etc., it is satisfactory at all. Moreover, you may be the configuration of forming a protective coat and sticking the include-angle conversion panel of light on the top face.

[0108] As mentioned above, according to the gestalt of this operation, conventionally, with a configuration, since the light which was useless can be taken out, optical ejection effectiveness can improve and the efficient luminescence engine performance can be maintained.

[0109] And it cannot be overemphasized that the organic electroluminescent element in the gestalt of this operation can be used as a lighting system or a display.

[0110] (Gestalt 2 of operation) Next, the display using the organic electroluminescent element of this invention is explained.

[0111] Drawing 8 is the outline perspective view of the display using the organic electroluminescent element in the gestalt of operation of this invention.

[0112] In drawing 8, a substrate 1, an anode plate 2, the electron hole transportation layer 3, a luminous layer 4, cathode 5, and the same sign as the gestalt 1 of ***** are attached, and explanation is omitted here.

[0113] In the gestalt of this operation, as shown in drawing 8, patterning of the anode plate 2 is carried out to the line, and patterning also of the cathode 5 is similarly carried out to this at the line in the form which carries out an abbreviation rectangular cross.

[0114] And if direct current voltage or a direct current is impressed to the anode plate 2 and cathode 5 which made the cathode 5 minus-side the anode plate 2 of this display plus-side, and were connected and chosen as the drive circuit (driver) as a driving means which is not illustrated, the luminous layer 4 of the part which intersects perpendicularly emits light, and it can be used as a display of a simple matrix method.

[0115] In the gestalt of this operation, it has the panel by which V typeface slot was formed in the component forming face of a substrate 1 as an include-angle conversion panel 6 of light. And it is desirable that the include-angle conversion panel of the light changes the include angle of the light emitted from a luminous layer into an include angle smaller than the critical angle which causes total reflection in the interface of a substrate and air.

[0116] In addition, the component of an anode plate 2, the electron hole transportation layer 3, a luminous layer 4, and cathode 5, the component which also mentioned the formation approach above, the formation approach, and a well-known thing can be used conventionally.

[0117] As mentioned above, also in the display of the gestalt of this operation, conventionally, with a configuration, since the light which was useless can be taken out, optical ejection effectiveness can improve and the efficient luminescence engine performance can be maintained. Moreover, in the display of the gestalt of this operation, since the orientation of light becomes strong in the direction of a transverse plane, while being able to control the optical propagation in the light transmission nature substrate in an optical ejection side and being able to maintain the efficient luminescence engine performance, it is possible to realize a display with sufficient visibility without an optical blot etc.

[0118] Moreover, in the gestalt of this operation, although the indicating equipment of a simple matrix method was explained, the indicating equipment of an active-matrix method is sufficient, the area of a light-emitting part can be effectively use for the nonluminescent sections, such as TFT use for a drive among the component forming faces of a substrate, by arrange V typeface slot, and the same efficient luminescence engine performance as the case where it is said simple matrix method can be maintain.

[0119] In addition, the organic electroluminescent element of this invention can be used also as lighting systems, such as the light source of a laser beam printer, a scanner, etc., only as a display which displays an image. Furthermore, without carrying out patterning to a line, an anode plate 2 and cathode 5 are made to emit light completely, and may be used as a mere lighting system.

[0120] (Gestalt 3 of operation) Next, the personal digital assistant using the organic electroluminescent element of this invention is explained. Drawing 9 is the perspective view showing the personal digital assistant equipped with the display which used the organic electroluminescent element of this invention, and drawing 10 is the block diagram showing the personal digital assistant equipped with the display which used the organic electroluminescent element of this invention.

[0121] The microphone from which 9 changes voice into a sound signal in drawing 9 and drawing 10, the loudspeaker from which 10 changes a sound signal into voice, The control unit by which 11 is constituted from a dial carbon button etc., and 12 are displays which display arrival of the mail etc., and consist of displays using the organic electroluminescence of this invention. The sending signal which is the transmitting section which 13 changes the sound signal from a microphone 9 into an antenna, and changes 14 into a sending signal, and was produced in the transmitting section 14 is emitted outside through an antenna 13. 15 is the receive section which changes into a sound signal the input signal which received with the antenna 13, and the sound signal created in the receive section 15 is changed into voice with a loudspeaker 10. 16 is a control section which controls the transmitting section 14, a receive section 15, a control unit 11, and a display 12.

[0122] The voice at the time of a message of a user (addresser) etc. is inputted, from a loudspeaker 10, the voice and the notice sound of the other party are outputted and a microphone 9 is transmitted to a user (addressee). In addition, as a personal digital assistant, when using a pager, it is not necessary to form especially a microphone.

[0123] Furthermore, the control unit 11 is equipped with the ten key and various kinds of function keys as a dial carbon button. Moreover, you may have the ten key, the not only various kinds of function keys but letter key, etc. From this control unit 11, predetermined data, such as a setup of the telephone number, a name, time of day, and various functions, E mail address, and URL, are inputted. Furthermore, not only the actuation by such keyboard but a pen input unit, an audio input unit, the MAG, or an optical input unit may be used for a control unit 11.

[0124] Data or character icons, such as the telephone number memorized by predetermined data and the memory into which a display 12 is inputted from a control unit 11, E mail address, and URL, etc. are displayed.

[0125] Moreover, an antenna 13 performs at least one side of transmission of an electric wave, or reception. In addition, with the gestalt of this operation, since transmission of a signal and reception were performed through radio, antennas (a helical antenna, flat antenna, etc.) were formed, but when performing optical communication etc., a light emitting device and a photo detector may be prepared instead of an antenna. In this case, a signal is transmitted to other communication equipment etc. by the light emitting device, and the signal from the outside is received by the photo detector.

[0126] The transmitting section 14 and a receive section 15 change into a sound signal the input signal which changed the sound signal into the sending signal and received, respectively.

[0127] Furthermore, the control section 16 is conventionally constituted by the well-known technique using CPU, memory, etc. which are not illustrated, and controls the transmitting section 14, a receive section 15 and a control unit 11, and a display 12. More specifically, an instruction is given to each control circuit, a drive circuit, etc. which were established in these each part and which are not illustrated. For example, the display-control circuit which received the display instruction from a control section 16 drives a display drive circuit, and a display is performed to a display 12.

[0128] An example of the actuation is explained below.

[0129] First, when there is arrival of the mail, a terminating signal will be sent out to a control section 16 from a receive section 15, a control section 16 displays a predetermined character etc. on a display 12 based on the terminating signal, if the carbon button of a purport which receives arrival of the mail from a control unit 11 further is pushed, a signal will be sent out to a control section 16 and a control section 16 will set each part as arrival-of-the-mail mode. That is, while the signal received with the antenna 13 is changed into a sound signal in a receive section 15 and a sound signal is outputted as voice from a loudspeaker 10, the voice inputted from the microphone 9 is changed into a sound signal, and is sent out outside through an antenna 13 through the transmitting section 14.

[0130] Next, the case where it sends is explained.

[0131] First, when sending, the signal of a purport sent from a control unit 11 is inputted into a control section 16. Then, if the signal equivalent to the telephone number is sent to a control section 16 from a control unit 11, a control section 16 sends out the signal corresponding to the telephone number from an antenna 13 through the transmitting section 14. If the communication link with the other party is established and a signal to that effect will be sent to a control section 16 through a receive section 15 by the sending-out signal through an antenna 13, a control section 16 will set each part as dispatch mode. That is, while the signal received with the antenna 13 is changed into a sound signal in a receive section 15 and a sound signal is outputted as voice from a loudspeaker 10, the voice inputted from the microphone 9 is changed into a sound signal, and is sent out outside through an antenna 13 through the transmitting section 14.

[0132] In addition, although the gestalt of this operation showed the example which carried out [voice] the transmit receive, effectiveness with the same said of the personal digital assistant which performs either [at least] transmission of data other than voice, such as not only voice but alphabetic data, or reception can be acquired.

[0133] In the personal digital assistant by the gestalt of such this operation, since the efficient luminescence engine performance is maintainable, the amount of the power used, such as a dc-battery, can be controlled. It is possible for this to attain lightweight-ization according to the miniaturization of a dc-battery in to enable long duration use of a personal digital assistant ****. It is called for that the display device used especially for a personal digital assistant is high definition more, and it is a low power, and high definition and efficient-ization bring about a big merit in recent years compared with the optical ejection of the conventional organic electroluminescent element. And by efficient-ization, streamlining of cell capacity is attained and lightweight-izing and long time-ization can be attained. Moreover, as a substrate of an organic electroluminescent element, if a high polymer film is used, it will become possible to bring about fast lightweight-ization.

[0134] moreover, the personal digital assistant aiming at an object for individual treatment like a personal digital assistant -- setting -- a user -- only he can recognize information and the property that information cannot be recognized is demanded from the perimeter, and since the design of making orientation of light strong in the direction of a transverse plane in the display device in this invention is possible, it is very effective to an application which was described above.

[0135]

[Example] (Example 1) aluminum film top after forming aluminum film of 160nm of thickness on the transparence substrate which consists of glass -- resist material (Tokyo adaptation shrine make, OFPR- 800) -- a spin coat method -- applying -- the resist film with a thickness of 10 micrometers -- forming -- a mask --

negatives were exposed and developed and patterning of the resist film was carried out to the predetermined configuration. Next, this substrate was immersed into 50% of hydrochloric acid at 50 degrees C, after etching aluminum film of a part with which the resist film is not formed, the resist film was also removed and the patterning substrate with which the anode plate which consists of aluminum film of a predetermined pattern was formed was obtained.

[0136] Next, after carrying out washing processing of this patterning substrate by ultrasonic cleaning for [it is based on 70-degree C pure water] 5 minutes, by the nitrogen blower, the moisture adhering to a substrate was removed, and it heated further and dried.

[0137] Next, within the resistance heating vacuum evaporationno equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, Alq3 was formed by about 60nm thickness as a luminous layer on cathode, and TPD was formed by about 50nm thickness as an electron hole transportation layer on the luminous layer. In addition, both the evaporation rates of TPD and Alq3 were 0.2 nm/s.

[0138] Next, within the low damage sputter equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, the mask was carried out with the metal mask, and on the electron hole transportation layer, the ITO film of 160nm of thickness was formed, and it considered as the transparence anode plate.

[0139] Next, the oxidation silicone film of 3 micrometers of thickness was similarly formed as a protective coat on said ITO film within low damage sputter equipment.

[0140] Next, the transparence resin plate which consists of a polycarbonate was cut in the one direction by the steel iron cutting tool of the symmetrical V character configuration formed in the pitch corresponding to the pixel formed of said anode plate and cathode by which patterning was carried out, and it considered as the include-angle conversion panel of light by which V typeface slot parallel to the one direction of [within a field] was formed.

[0141] Next, the adhesives for optics were uniformly applied to said protective coat front face, and the include-angle conversion panel of said light was stuck.

[0142] (Example 2) the transparence substrate which consists of glass -- a detergent (fruity chemistry company make --) SEMIKO -- being clean -- ultrasonic cleaning for [it depends] 5 minutes, and ultrasonic cleaning for [it is based on pure water] 10 minutes -- After carrying out washing processing at the order of ultrasonic cleaning for [it is based on the solution which mixed hydrogen peroxide solution 1 and water 5 to aqueous ammonia 1 (volume ratio)] 5 minutes, and ultrasonic cleaning for [it is based on 70-degree C pure water] 5 minutes, by the nitrogen blower, the moisture adhering to a substrate was removed and it dried.

[0143] Next, the cathode by which patterning was carried out with the metal mask by making the aluminum-Li alloy containing 15at% Li into the source of vacuum evaporationno within the resistance heating vacuum evaporationno equipment which decompressed the substrate to the degree of vacuum of 2×10^{-6} or less Torr was formed by 150nm thickness.

[0144] Next, similarly, within resistance heating vacuum evaporationno equipment, Alq3 was formed by about 60nm thickness as a luminous layer on cathode, and TPD was formed by about 50nm thickness as an electron hole transportation layer on the luminous layer. In addition, both the evaporation rates of TPD and Alq3 were 0.2 nm/s.

[0145] Next, within the low damage sputter equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, the mask was carried out with the metal mask and the ITO film of 160nm of thickness was formed on the electron hole transportation layer.

[0146] Next, the silicon nitride film of 3 micrometers of thickness was similarly formed as a protective coat on the organic toothing-like electroluminescent element within low damage sputter equipment.

[0147] Next, the transparence resin plate which consists of PMMA (acrylic) is cut in the one direction by the steel iron cutting tool of the symmetrical V character configuration formed in the pitch corresponding to the pixel formed of said anode plate and cathode by which patterning was carried out. Furthermore, 90 degrees of transparence resin plates with which said V typeface slot was formed were rotated, and similarly, it cut by said steel iron cutting tool, and considered as the include-angle conversion panel of light by which V typeface slot parallel to the 2-way which intersects perpendicularly mutually in a field was formed.

[0148] Next, after applying to said protective coat front face uniformly the optical binder which consists of ethylene glycol and sticking the include-angle conversion panel of said light on it using surface tension, four corners of the include-angle conversion panel of light were fixed using adhesives.

[0149] (Example 3) the opaque substrate which consists of silicon -- a detergent (fruity chemistry company make --) SEMIKO -- being clean -- ultrasonic cleaning for [it depends] 5 minutes, and ultrasonic cleaning for [it is based on pure water] 10 minutes -- After carrying out washing processing at the order of ultrasonic cleaning for [it is based on the solution which mixed hydrogen peroxide solution 1 and water 5 to

aqueous ammonia 1 (volume ratio)] 5 minutes, and ultrasonic cleaning for [it is based on 70-degree C pure water] 5 minutes, by the nitrogen blower, the moisture adhering to a substrate was removed and it dried.

[0150] Next, the cathode by which patterning was carried out with the metal mask by making the aluminum-Li alloy containing 15at% Li into the source of vacuum evaporation within the resistance heating vacuum evaporation equipment which decompressed the substrate to the degree of vacuum of 2×10^{-6} or less Torr was formed by 150nm thickness.

[0151] Next, similarly, within resistance heating vacuum evaporation equipment, Alq₃ was formed by about 60nm thickness as a luminous layer on cathode, and TPD was formed by about 50nm thickness as an electron hole transportation layer on the luminous layer. In addition, both the evaporation rates of TPD and Alq₃ were 0.2 nm/s.

[0152] Next, within the low damage sputter equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, the mask was carried out with the metal mask and the ITO film of 160nm of thickness was formed on the electron hole transportation layer.

[0153] Next, the oxidation silicone film of 3 micrometers of thickness was similarly formed as a protective coat on the organic tooth-like electroluminescent element within low damage sputter equipment.

[0154] Next, the steel iron metal mold with which the symmetry V typeface projection parallel to the 2-way which intersects perpendicularly mutually in a field in the pitch corresponding to the pixel formed of said anode plate and cathode by which patterning was carried out was formed, and the include-angle conversion panel of light which consists of a polycarbonate was formed by hot working.

[0155] Next, the light-scattering film was stuck on the field in which V typeface slot of the include-angle conversion panel of said light was formed, and the field which counters, and it considered as the include-angle conversion panel of the light whose optical ejection side is the diffusing surface.

[0156] Next, the adhesives for optics were uniformly applied to said protective coat front face, and the include-angle conversion panel of said light was stuck.

[0157] (Example 4) aluminum film top after forming aluminum film of 160nm of thickness on the transparence substrate which consists of glass -- resist material (Tokyo adaptation shrine make, OFPR- 800) -- a spin coat method -- applying -- the resist film with a thickness of 10 micrometers -- forming -- a mask -- negatives were exposed and developed and patterning of the resist film was carried out to the predetermined configuration. Next, this substrate was immersed into 50% of hydrochloric acid at 50 degrees C, after etching aluminum film of a part with which the resist film is not formed, the resist film was also removed and the patterning substrate with which the anode plate which consists of aluminum film of a predetermined pattern was formed was obtained.

[0158] Next, after carrying out washing processing of this patterning substrate by ultrasonic cleaning for [it is based on 70-degree C pure water] 5 minutes, by the nitrogen blower, the moisture adhering to a substrate was removed, and it heated further and dried.

[0159] Next, within the resistance heating vacuum evaporation equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, Alq₃ was formed by about 60nm thickness as a luminous layer on cathode, and TPD was formed by about 50nm thickness as an electron hole transportation layer on the luminous layer. In addition, both the evaporation rates of TPD and Alq₃ were 0.2 nm/s.

[0160] Next, within the low damage sputter equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, the mask was carried out with the metal mask, and on the electron hole transportation layer, the ITO film of 160nm of thickness was formed, and it considered as the transparence anode plate.

[0161] Next, the oxidation silicone film of 3 micrometers of thickness was similarly formed as a protective coat on said ITO film within low damage sputter equipment.

[0162] Next, the steel iron metal mold with which the asymmetry V typeface projection parallel to the 2-way which intersects perpendicularly mutually in a field in the pitch corresponding to the pixel formed of said anode plate and cathode by which patterning was carried out was formed, and the include-angle conversion panel of light which consists of a polycarbonate was formed by hot working.

[0163] Next, the adhesives for optics were uniformly applied to said protective coat front face, and the include-angle conversion panel of said light was stuck.

[0164] (Example 5) aluminum film top after forming aluminum film of 160nm of thickness on the transparence substrate which consists of glass -- resist material (Tokyo adaptation shrine make, OFPR- 800) -- a spin coat method -- applying -- the resist film with a thickness of 10 micrometers -- forming -- a mask -- negatives were exposed and developed and patterning of the resist film was carried out to the predetermined configuration. Next, this substrate was immersed into 50% of hydrochloric acid at 50 degrees C, after etching aluminum film of a part with which the resist film is not formed, the resist film was also removed

and the patterning substrate with which the anode plate which consists of aluminum film of a predetermined pattern was formed was obtained.

[0165] Next, after carrying out washing processing of this patterning substrate by ultrasonic cleaning for [it is based on 70-degree C pure water] 5 minutes, by the nitrogen blower, the moisture adhering to a substrate was removed, and it heated further and dried.

[0166] Next, within the resistance heating vacuum evaporationno equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, Alq₃ was formed by about 60nm thickness as a luminous layer on cathode, and TPD was formed by about 50nm thickness as an electron hole transportation layer on the luminous layer. In addition, both the evaporation rates of TPD and Alq₃ were 0.2 nm/s.

[0167] Next, within the low damage sputter equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, the mask was carried out with the metal mask, and on the electron hole transportation layer, the ITO film of 160nm of thickness was formed, and it considered as the transparence anode plate.

[0168] Next, the oxidation silicone film of 3 micrometers of thickness was similarly formed as a protective coat on said ITO film within low damage sputter equipment.

[0169] Next, the transparence resin plate which consists of PMMA (acrylic) is cut in the one direction by the steel iron cutting tool of the symmetrical V character configuration formed in the pitch corresponding to the pixel formed of said anode plate and cathode by which patterning was carried out. Furthermore, 90 degrees of transparence resin plates with which said V typeface slot was formed were rotated, and similarly, it cut by said steel iron cutting tool, and considered as the include-angle conversion panel of light by which V typeface slot parallel to the 2-way which intersects perpendicularly mutually in a field was formed.

[0170] The include-angle conversion panel of said light next, within the resistance heating vacuum evaporationno equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr The side face considered as the include-angle conversion panel of light which is a light reflex side by cutting 1 micrometer of fields by the side of V typeface slot where aluminum was formed in the front face in which V typeface slot was formed by about 100nm thickness as a light reflex layer, and aluminum light reflex layer was further formed in it using polish equipment.

[0171] Next, after applying to said protective coat front face uniformly the optical binder which consists of ethylene glycol and sticking the include-angle conversion panel of said light on it using surface tension, four corners of the include-angle conversion panel of light were fixed using adhesives.

[0172] (Example 1 of a comparison) aluminum film top after forming aluminum film of 160nm of thickness like an example 1 on the transparence substrate which consists of glass -- resist material (Tokyo adaptation shrine make, OFPR- 800) -- a spin coat method -- applying -- the resist film with a thickness of 10 micrometers -- forming -- a mask -- negatives were exposed and developed and patterning of the resist film was carried out to the predetermined configuration. Next, this substrate was immersed into 50% of hydrochloric acid at 60 degrees C, after etching aluminum film of a part with which the resist film is not formed, the resist film was also removed and the patterning substrate with which the anode plate which consists of aluminum film of a predetermined pattern was formed was obtained.

[0173] Next, after carrying out washing processing of this patterning substrate by ultrasonic cleaning for [it is based on 70-degree C pure water] 5 minutes, by the nitrogen blower, the moisture adhering to a substrate was removed, and it heated further and dried.

[0174] Next, within the resistance heating vacuum evaporationno equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, Alq₃ was formed by about 60nm thickness as a luminous layer on cathode, and TPD was formed by about 50nm thickness as an electron hole transportation layer on the luminous layer. In addition, both the evaporation rates of TPD and Alq₃ were 0.2 nm/s.

[0175] Next, within the low damage sputter equipment decompressed to the degree of vacuum of 2×10^{-6} or less Torr, the mask was carried out with the metal mask, and on the electron hole transportation layer, the ITO film of 160nm of thickness was formed, and it considered as the transparence anode plate.

[0176] Next, the oxidation silicone film of 3 micrometers of thickness was similarly formed as a protective coat on the organic toothing-like electroluminescent element within low damage sputter equipment.

[0177]

[Table 1]

	発光効率	正面輝度	発光面視認性
実施例 1	○	○	○
実施例 2	◎	◎	◎
実施例 3	◎	○	○
実施例 4	◎	○	△
実施例 5	◎	◎	△
比較例 1	△	△	△

[0178] Here, the evaluation approach in the evaluation criteria of (Table 1) and its valuation basis are explained.

[0179] The luminous efficiency of a component evaluated the sum of the luminescence brightness in the omnidirection when passing a fixed current to an organic electroluminescent element. the valuation basis -- the luminous efficiency of the example 1 of a comparison -- receiving -- O: -- it excels very much -- O: excel -- it can do **:permission -- it comes out.

[0180] The transverse-plane brightness of a component evaluated the luminescence brightness in the direction of a transverse plane when passing a fixed current to an organic electroluminescent element. the valuation basis -- the transverse-plane brightness of the example 1 of a comparison -- receiving -- O: -- it excels very much -- O: excel -- it can do **:permission -- it comes out.

[0181] The visibility of a luminescence side evaluated extent of visibility by viewing about a blot of the light in the direction of a transverse plane when using an organic electroluminescent element as the display which consists of a 300micrometerx300micrometer pixel, and dotage. evaluation -- three-step evaluation of O, O, and ** -- it is -- the valuation basis -- O: -- it excels very much -- O: excel -- it can do **:permission -- it comes out.

[0182]

[Effect of the Invention] As mentioned above, according to this invention, the organic electroluminescent element which has an efficient luminescence brightness property, the display using it, a personal digital assistant, and a lighting system can be offered by sticking the include-angle conversion panel of light on an organic electroluminescent element front face. Moreover, the display and personal digital assistant using the organic electroluminescent element which had a specific angle-of-visibility property that there are little blot and optical dotage, and it can be offered by adjusting dispersion in the symmetric property and the optical ejection side of mesa mold structure.

[Translation done.]

* NOTICES *

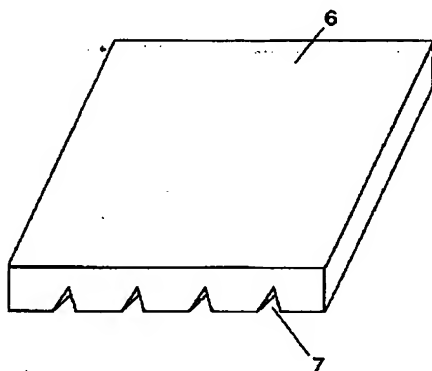
JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

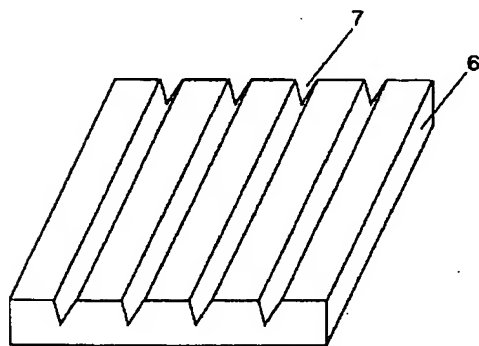
DRAWINGS

[Drawing 1]

(a)

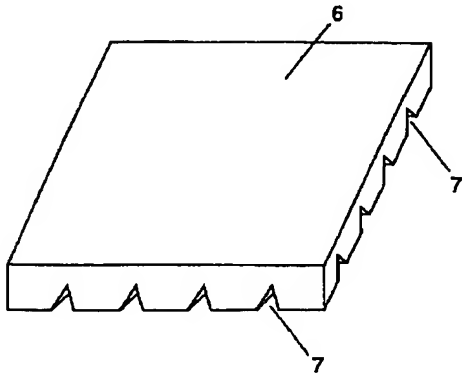


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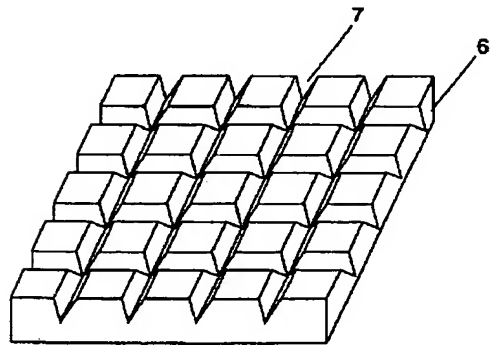
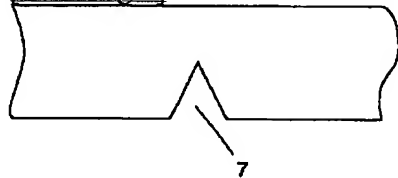
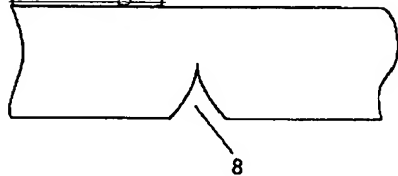
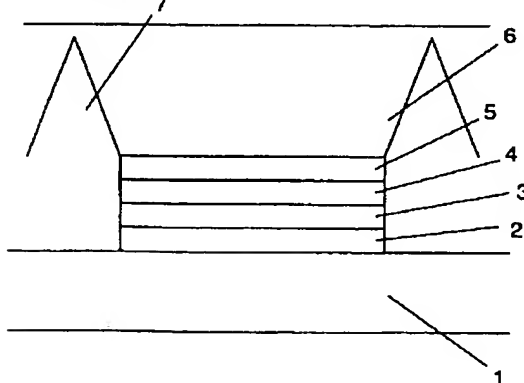


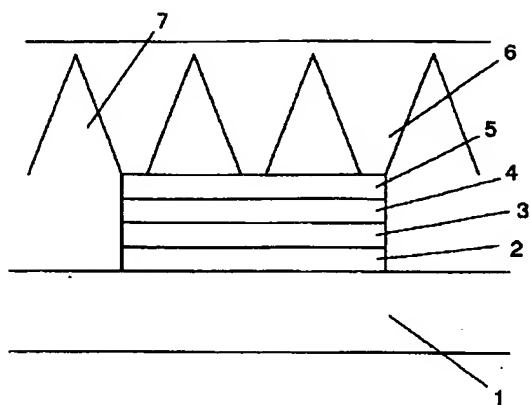
[Drawing 2]

(a)

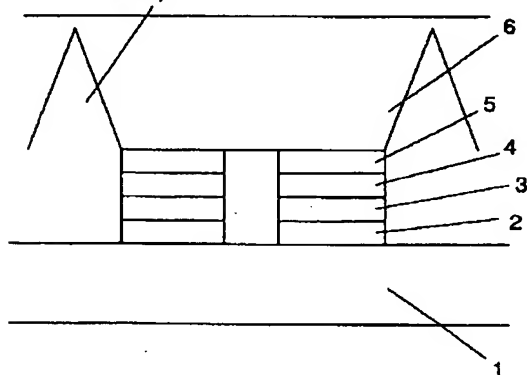


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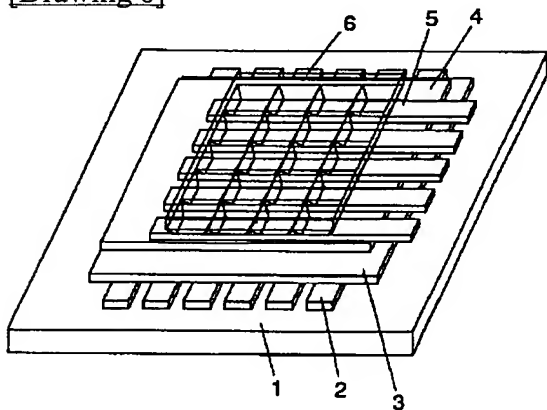
[Drawing 3][Drawing 4][Drawing 5][Drawing 6]



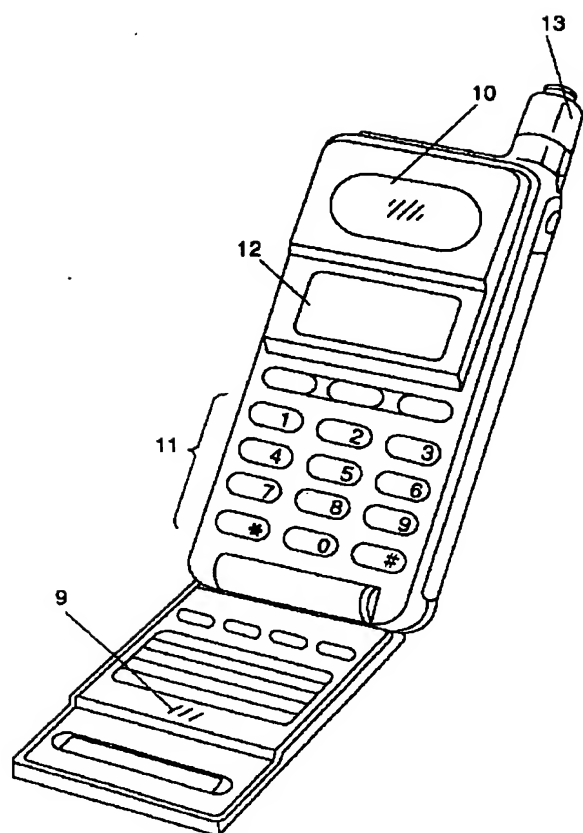
[Drawing 7]



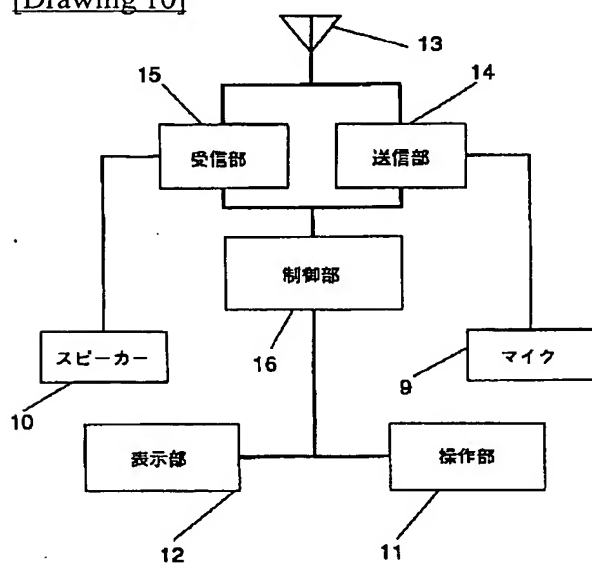
[Drawing 8]



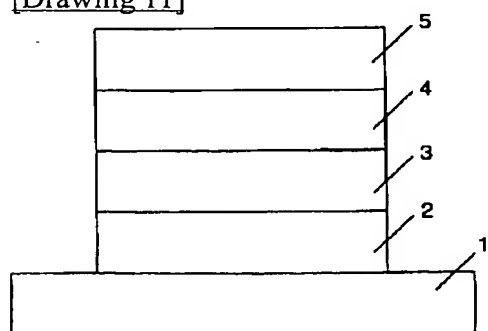
[Drawing 9]

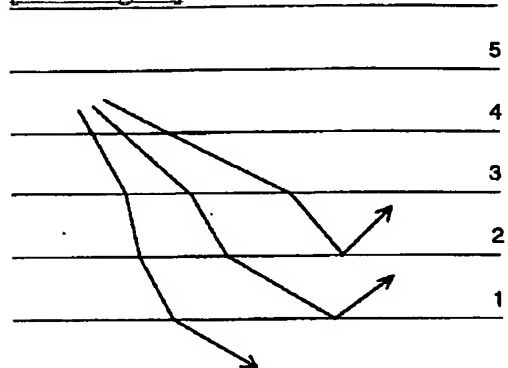


[Drawing 10]



[Drawing 11]



[Drawing 12]

[Translation done.]